

Review of Abraham Pais

Niels Bohr's Times, in Physics, Philosophy, and
Polity

Clarendon Press, Oxford, 1991, pp. xvii + 565.

In 1982 Abraham Pais ~~fully~~ produced his much-
-acclaimed biography of ^{Albert} Einstein entitled 'Sutcliffe
is the Lord ---'. Pais has now produced what
is in effect a companion volume on Niels Bohr.

The new book is planned on similar lines
to the Einstein volume. Meticulously researched
biographical detail is interlarded with very
clear and accurate presentations of the relevant
physics, and interspersed are Pais's own
personal recollections and assessments. As
with Einstein Pais knew Bohr ^{well} in later
life and so is ideally equipped to
undertake both these biographies. In
one of the most interesting sections of the new
book Pais compares and contrasts these two
dominating figures in twentieth-century physics.

Bohr were possessed if not obsessed by physics,
as Pais puts it. Einstein's spectrum of scientific
activities was the broader, comprehending of
course statistical physics and quantum theory
as well as relativity, while Bohr concentrated
almost entirely on quantum theory and its
ramifications. But there were two striking
differences. Bohr identified very strongly with his
native Denmark, and created a major research

Except school in Copenhagen, the famous Niels Bohr Institute. Although he never supervised Ph.D. students as such, he did his best work in endless discussion with the stream of visitors and research workers at the Institute. By contrast, Einstein never identified with any particular country, fair describes him living and working in many different places, and although he had ~~some~~ quite a number of collaborators on an individual basis, he never in any sense created a research school.

Pais traces in fascinating detail the profound disagreement between Einstein and Bohr on the interpretation of quantum mechanics. Bohr developed his complementarity interpretation in 1927 and this rapidly became the orthodox view, while Einstein's repeated attempts to test out inconsistencies and incoherences in Bohr's position, were famously refuted by Bohr. So Einstein became the lone defender, so far as the mainstream physics community was concerned, and it is only recently with the work of the late John Bell, and that renewed interest in Einstein's arguments brought the whole subject of the interpretation of quantum mechanics back to something like the centre stage of physicists' attention.

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But this belongs to the period after Bohr's death, and is not even referred to in Pais's book. Pais remains himself fully committed to the orthodox position and comments that he has been unable to appreciate what

all the fun is about!

Bohr has much to say about Bohr's scientific 'style'. He never felt comfortable with the highly mathematical aspects of theoretical physics. His arguments were often presented in ~~an intuitive~~ ^{a qualitative} style without mathematical elaboration.

Despite his elaborate reworking of many drafts of his papers, more philosophical papers, and other great efforts at clarity, the texts remain obscure and ambiguous. But as Easwaran remarked: "He utters his opinions like one perpetually groping and never like one who believes he is in possession of definite truths".

Bohr himself believed that his insights concerning complementarity while arising from attempts to interpret quantum mechanics, were relevant to elucidating ^{fundamental} puzzles in 'many other fields' such as biology, psychology and sociology. [So how, at the end of the day, should we assess Bohr's contribution to physics?]

The 1913 paper introducing the quantum theory of atomic structure was of course the seminal work in the so-called old quantum theory, and the subsequent elaborations in particular in collaboration with ^{Hendrik} Kramers and wonderfully exploring the Copenhagen principle leading the quantum theory with classical results in the limit of high quantum numbers, show Bohr at his most typical, groping towards results, but getting sensible answers in decidedly neptunian ways. As Kramers snarled: "the Copenhagen principle appeared to the rest of physicists as a rather neptunian mad, but did not work outside Copenhagen".

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However, Bohr did not always get it right. Briefly
 in 1924 Bohr flinched with abandoning ^{strict} energy
 conservation in atomic processes, as an alternative
 to Einstein's photons, but the following year
 Compton and Simon showed decisively that that
 was not a viable option. [In the new
 quantum mechanics inaugurated by ^{Werner} Heisenberg
 in 1925 Bohr's main role was in questions
 of interpretation and the analysis of experiments.
 Physicists, other than Einstein,
 were generally content to leave such matters
 to the one person who seemed capable of
 understanding everything, viz. Niels Bohr. The
 culmination of this work is undoubtedly the
 analysis he provided, in collaboration with
 Leon Rosenfeld, in 1933 of 'the uncertainty relations
 for field strengths in quantum electrodynamics'.
 This paper is a tour-de-force, and even Pais
 admits he is not sure he has mastered all
 the fine points of the arguments.
 But in the 1930's Bohr turned his attention
 formerly to nuclear physics, and his idea
 of the compound nucleus was a genuine
 and original contribution to elementary nuclear
 the theory of nuclear reactions.
 But apart from his physics Bohr also worked
 tirelessly in later years for 'the raising of
 atomic secrets'. Pais gives a very interesting
 and detailed account of these political matters.
 The En Summary de Bohr is a masterpiece of
 its genre, and I recommend it as a fitting
 tribute to one of the world's greatest physicists.